What is RESRAD?

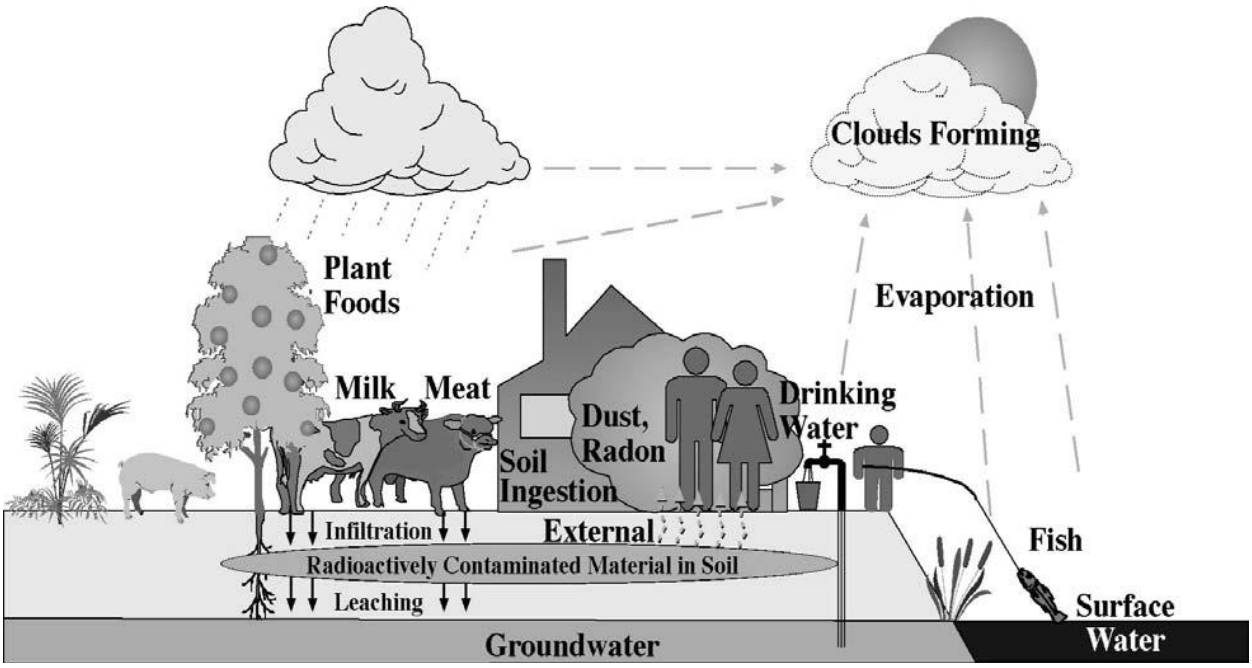
The Tennessee Department of Environment and Conservation's Division of Radiological Health (DRH) uses the RESRAD computer code as a primary tool to predict and control radiation doses from the extremely low levels of radioactive material that are disposed in approved Class I landfills under the BSFR program.

RESRAD is a computer model designed to estimate radiation doses and risks from RESidual RADioactive materials. RESRAD uses hydrogeological, meteorological, geochemical, geometrical (size, area, depth), and material-related (soil, concrete) factors for determining radiation doses and risks. Doses are determined by considering the various pathways through which an individual can be exposed to the radiation, and include:

- Direct exposure to external radiation from the contaminated soil material;
- Internal dose from inhalation of airborne radioactive materials, including radon progeny; and
- Internal dose from ingestion of:
  - Plant foods grown in the contaminated soil and irrigated with contaminated water,
  - Meat and milk from livestock fed with contaminated fodder and water,
  - Drinking water from a contaminated well or pond,
  - Fish from a contaminated pond, and
  - Contaminated soil.

RESRAD has been widely used by the U.S. Department of Energy (DOE), its operations and area offices, and its contractors for deriving limits for radioactive materials in soil. RESRAD has also been used by the U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers, U.S. Nuclear Regulatory Commission (NRC), industrial firms, universities, and foreign government agencies and institutions including those of France, Spain, Germany, Russia, Taiwan, Japan, Belgium, Croatia, Malaysia, the Czech Republic, and Canada.

Exposure Pathways Considered in RESRAD



One scenario considered in using RESRAD to determine acceptable disposal limits is that of the "resident farmer", which is depicted in the graphic on the previous page. This scenario assumes that, once the landfill is released from post-closure monitoring, a farmer buys the landfill property, builds a house on top of the wastes disposed there, resides there, drills a well, and uses the water to drink, cook, bathe, and irrigate crops. It is assumed that the farmer has livestock that eat the crops and grass and drink the water, and that the farmer consumes the crops, livestock, and milk from the cows. In reality there will be a soil cover placed over the site, which will reduce the radiation dose, however, in calculating the projected radiation dose, DRH assumes no cover, that is, it assumes direct contact with landfilled wastes. In calculating the projected dose from groundwater use, it is assumed that the synthetic liner, which is designed to prevent landfill leachate from entering the groundwater, doesn't exist. The BSFR program includes numerous other such conservatisms. The disposal limits are established such that, even in this most extreme scenario, including such conservatisms, the dose projected to be received by a resident farmer would not exceed the one millirem per year dose criterion, at any time from the present out to 1000 years in the future. Any potential dose from BSFR waste to individuals living adjacent to the landfill, as opposed to living on it as would the postulated resident farmer, would be expected to be much closer to zero than to one millirem per year.

Compliance with the one millirem per year dose criterion is assessed through determination of, and required adherence to, allowable quantities and concentrations of radioactive material in BSFR waste that is placed in the landfill throughout the operating lifetime of the landfill.

The quantities and concentrations of radioactive materials that would result in a dose of one millirem per year, once the landfill is closed, from all BSFR waste placed into the landfill over its entire operating lifetime, are calculated using the RESRAD code. These quantities and concentrations are imposed by DRH on the BSFR processors as operational license limits. Each load of BSFR waste is required to comply with the concentration limits calculated using RESRAD, and the overall quantity of BSFR waste disposed can amount to no more than 5% of the total waste disposed at the landfill. The dose should actually be well below the design criterion of one millirem per year, for several reasons. For example, the BSFR program itself includes numerous conservatisms, such as those described above, which would result in the actual dose to any individual being much less than the design dose criterion of one millirem per year; the amount of waste going through the BSFR program is actually far less than the 5% limit; and the concentrations of radioactive material in loads of BSFR waste are often significantly less than the allowed limits.